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NATURALLY OCCURRING HOST SITES FOR XYLOPHILIC CECIDOMYIIDAE (DIPTERA)

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Abstract.—Existing data on host sites for xylophilic Cecidomyiidae larval development are derived from observations of sawn trees and logs. Field studies of hardwood trees at three sites in northeast Ohio show that strong winds and animal activity break live branches of suitable size and thus expose vessels of $\geq 75\ \mu$ which are used for larval development. Such damaged branches can support large populations of midges. Larvae develop in both the proximal and distal sides of the break. Branches remain suitable for oviposition and larval development for one to several months, depending on branch diameter and weather conditions.

Key Words: wood loving, tree damage, squirrel activity

Xylophilic Cecidomyiidae use freshly exposed vessels of hardwoods as a larval habitat. Relationship between host selection and vessel diameter has been previously reported (Rock and Jackson 1985, 1986). As with that of other investigators (Kieffer 1900, Brues 1922), our initial encounter with these cecidomyiids began when we observed females swarming on the cut surfaces of logs and stumps of trees exposed in logging operations. Although we also used cut logs during earlier studies, we speculated on the availability of such niches under natural conditions. Our current investigation examines 1) the role of strong winds and animal activity in exposing larval niches, 2) utilization of vessels in live branches that remain on the tree, 3) the number of larvae that one branch can support and 4) the length of time after exposure that a branch remains suitable for use.

Methods

Storm and squirrel damage.—Two sites in northeast Ohio were monitored for two years (1985 and 1986) for live, broken branches. One site was a small island of approximately 7500 square meters located near a lake shore with five mature oak (*Quercus alba* L.) and one mature ash (*Fraxinus americana*) trees (known xylophilic cecidomyiid hosts (Rock and Jackson 1986)). The other was part of a large suburban garden with a study area of 5625 square meters with five mature oak and three mature ash trees. The areas below the trees were mowed regularly to facilitate collection of fallen twigs and branches. We recorded the diameter of only the live branches because previous studies have shown that dead wood is not a suitable larval habitat. Some larger branches were kept at the field site to monitor their use by cecidomyiids. The suitability of the branches for larval development was verified by subsequent collection of larvae from the branch ends.

Squirrels were active at the field sites and numerous live host tree branches were collected that squirrels had severed by chewing. Branches broken by squirrels were

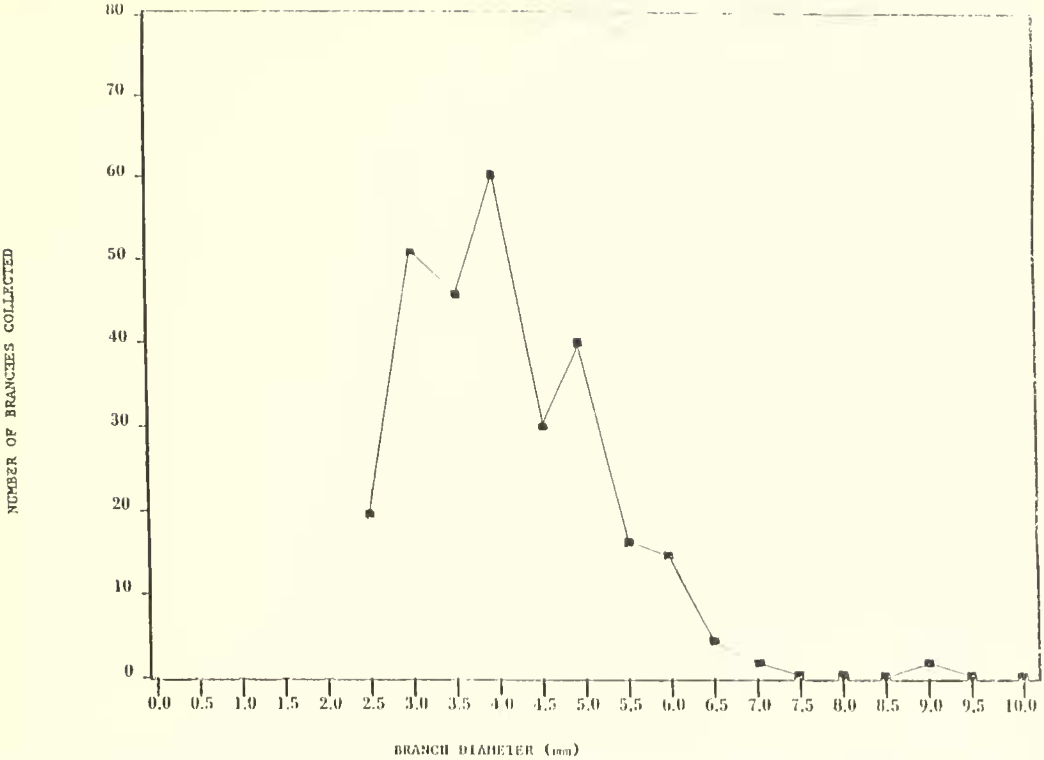

Fig. 1. Number and size of live branches broken from hardwood hosts at test sites. Branches <2 mm d not included in collection.

readily identified by teeth marks. Branch diameters were recorded.

Suitability of proximal section of broken branches.—In earlier studies, we had for convenience used only the severed branch sections. The current study investigates the use of the intact basal parts as their use would double the number of potential larval development sites.

We cut a total of fifty-nine branches ranging from 13 mm d to 30 mm d from ash, oak and elm trees at field sites in Akron and Orrville, Ohio. The severed branches were placed at the base of the tree to confirm the presence of females. Branch ends on the trees were left exposed for ten days to allow females to oviposit. After this time, the ends were covered by a plastic cup; the branch and cup were then covered with a nylon bag to hold the cup in place. Rain wetting the branches stimulated the emergence of larvae. We recorded the number of larvae that fell into the cups without identifying them to species. The branches were uncovered for three days to allow for possible further oviposition; the cups were then replaced. This procedure was repeated for up to seven weeks.

Potential larval yield from small branches.—We had previously determined that host branches of 6 mm or greater in diameter usually contain xylem vessels of ≥ 75 μ d, which are suitable for larval development (Rock and Jackson 1986), but never recorded the number of midges that emerged from indvidual twigs. Twenty sassafras (*Sassafras albidum* (Nutt.) Nees) branches with diameters varying from 3 mm to 20 mm were offered to a population of 300 caged *Xylodiplosis longistylus* Gagné females for one week. The branches were held at room temperature in plastic bags for 14

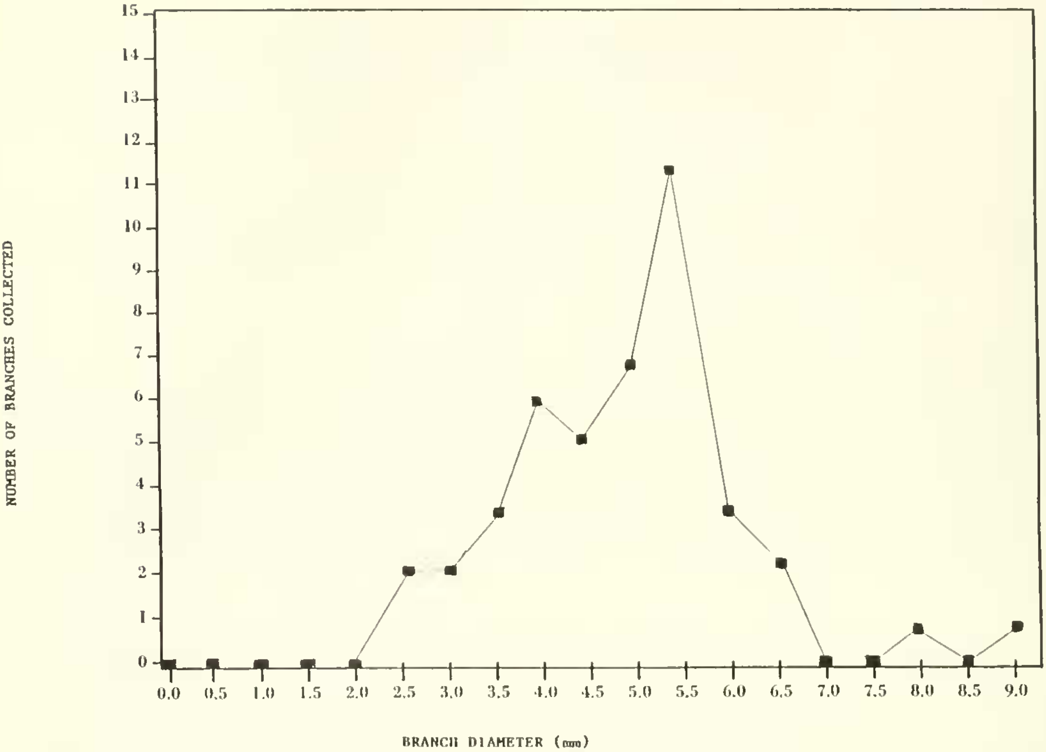

Fig. 2. Number and size of live branches broken from host trees by squirrel activity.

days. Each was then soaked in a separate container of water, and the number of larvae emerging from both exposed ends was recorded.

Period of suitability of cut branches for larval development.—To establish if there was a connection between length of use of a severed branch and branch diameter, we monitored larval emergence in branch samples of various diameters from the field sites. Unidentified xylophilic larvae emerged from vessels in approximately 14 days after oviposition if the branch was soaked in water (Rock and Jackson 1985). When a wood sample ceased to yield larvae, we assumed it had lost its attractiveness to females approximately two weeks earlier. We then compared duration of attractiveness to sample diameter.

Results and Discussion

Strong winds create a source of suitable oviposition sites. Although the majority of the live branches broken from host trees during an entire summer are <5 mm d (Fig. 1), high winds break off some branches of 6 mm d or greater, which contain suitably sized vessels. Branches with diameters ranging from 15 mm to 35 mm were occasionally broken throughout the summer. At other locations we observed major damage due to lightning and heavy snow that also created sources of exposed vessels. As discussed below, the availability of larger branches is very important as they can support several generations of gall midges each summer.

Squirrels expose the ends of live branches when they feed and build their nests (Shorten 1954). Although most of the branches are less than 6 mm d (Fig. 2), some larger branches are severed and can serve as suitable sites for midge development. Gray squirrels (*Sciurus nigra*) are known to build nests in many of the hardwoods that are also hosts to xylophilic midges. Uhlig (1955), in

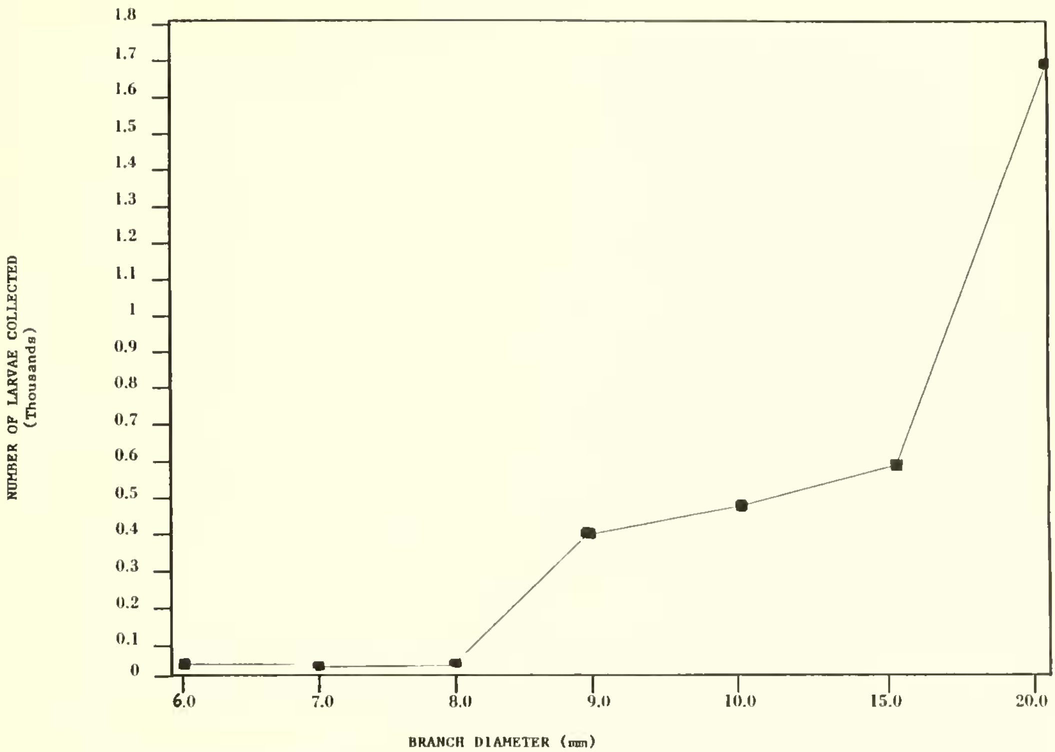

Fig. 3. Relationship of number of larvae collected to branch diameter: *Sassafras albidum*.

an extensive study of the gray squirrel in West Virginia, noted the use of oak, elm, and hickory, and less frequently willow, walnut, and sassafras, in nest building. Walnut and oak trees at our field sites contained squirrel nests. Leaf nests built of twigs and leaves from the tree in which they are located have been noted from early spring throughout the summer months. Juvenile squirrels are the primary leaf nest builders, and the actual number of nests is directly proportional to the rearing success of the spring and summer litters (Uhlig 1955). One juvenile may build more than one nest throughout the summer and early fall. Thus, with several juvenile squirrels in an area, a supply of exposed branches exists for several months.

Fig. 3 summarizes a laboratory study, using sassafras, which shows a direct correlation between branch diameter and the number of larvae collected. We previously determined that larvae require vessels of $\geq 75\ \mu$ d for development and that it is possible to predict the number of potential larval habitats based on the number of vessels/mm^2 in the sapwood. The 6 to 8 mm d branches are suitable for larval development but each yielded only a few larvae. However, the 20 mm d sassafras sample had approximately 1850 vessels $\geq 75\ \mu$ d/mm^2 in each end, and it yielded over 1700 larvae.

Preliminary field data indicate that actual utilization of vessels is much less than in laboratory samples. A 12 mm d ash branch, for example, yielded 6 larvae, and a 50 mm d branch yielded 100 larvae during 12 days of field collecting. In natural conditions, small, broken branches are available to the flies throughout the summer and can support small overlapping populations. Although large branches are available less frequently, they permit rapid population increases and provide larval niches for extended periods of time.

The live basal sections of severed branch-

Table 1. Relationship of host sample diameter to length of attractiveness.

Host Plant	Diameter (cm)*	Length of Attrac- tiveness (Weeks)
Juglans nigra L.	35	15
Fraxinus americana	22	10
Carya ovata (Mill.) K. Koch	21	12
Quercus alba L.	14	14
Ulmus americana L.	12	14
Populus deltoides Bartr.	12	10
U. americana	11	11
Salix babylonica Marsh	9	8
Sassafras albidum (Nutt.) Nees	7	8
F. americana	5	8
F. americana	2 to 4	8
F. americana	1 to 2	6
F. americana	0.6 to 1	4

* All samples 25 to 35 cm long.

es are attractive to females and suitable for larval development. Larvae emerged from most of the attached broken branches, the largest number collected at one time being 30 from a 30 mm ash branch. No larvae emerged after the sixth week of exposure, and we assumed branches had ceased to attract female midges.

The time period during which midges utilize a cut branch (Table 1) is directly proportional to its diameter. As the life cycle of most xylophilic species is approximately 4 weeks, during the summer in northeast Ohio it is possible for one 35 cm d log to support three generations of gall midges. Major factors that limit the period of attractiveness are speed of decay and rainfall. General observations over several summers indicate that abnormally wet periods promote fungal growth on exposed branch ends and so reduce the length of time that a log is suitable. Weather records, however, indicate that summers with increased shower activity are associated with more frequent episodes of high winds which lead to an increase in the number of severed branches (Robert Thompson, personal communication, National Weather Service, North Canton, Ohio 1988).

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